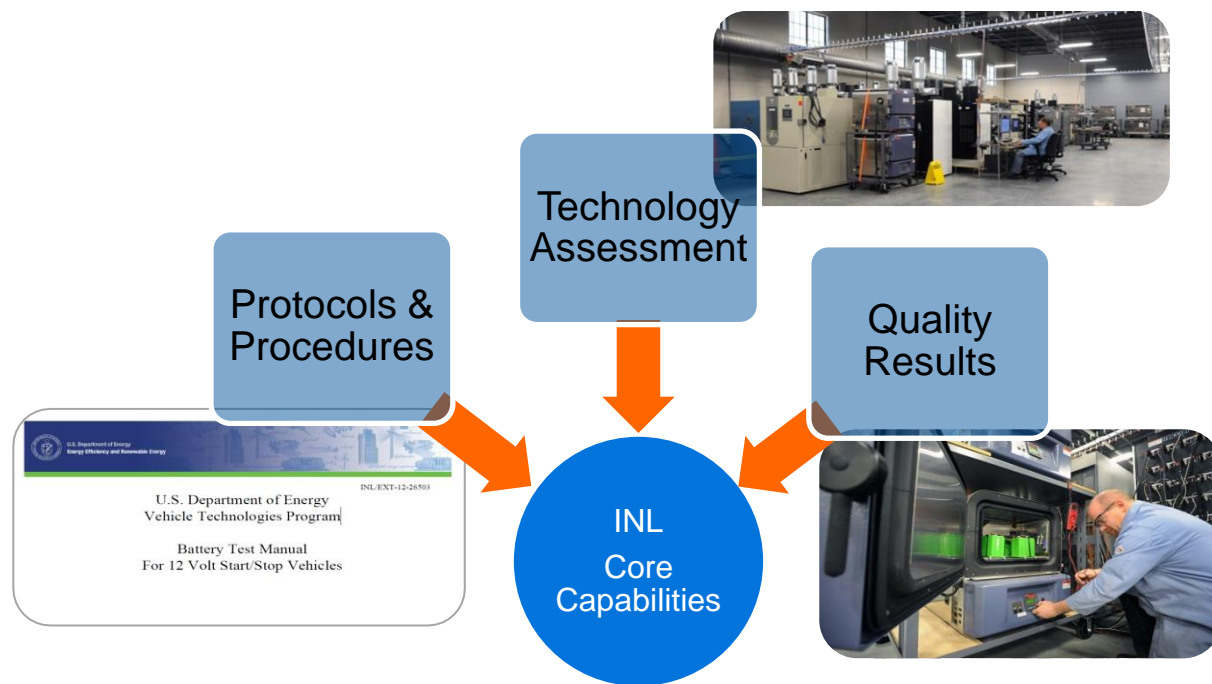


CALIBRATED for SUCCESS



Randy Bewley

INL Tech-to-Market (T2M) Workshop

May 19-20, 2015

Data Integrity

Our main product is DATA

- **Everything we use is NIST traceable through the INL Standards and Calibration Laboratory (S&CL)**
- **INL (SC&L) is accredited Through the National Voluntary Laboratory Accreditation Program (NVLAP) administered by NIST**
- **Accredited under NVLAP Code 200115-0**

Data Integrity

INL (SC&L) is accredited in 9 areas:

- 1. Quality and Technical – ISO/IEC 17025; 2005 and ANSI/NCSL Z540-1**
- 2. Time and Frequency**
- 3. DC Voltage**
- 4. Resistance**
- 5. Length**
- 6. Force**
- 7. Pressure**
- 8. Mass**
- 9. Temperature**

Yearly NVLAP audit



CALIBRATION LABORATORIES

NVLAP LAB CODE 200115-0

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

<p>Idaho National Laboratory - Calibration Services Dept. P. O. Box 1625 Idaho Falls, ID 83415-4137 Mr. Michael Stears Phone: 208-526-2343 Fax: 208-526-5462 E-mail: michael.stears@inl.gov URL: http://info.inel.gov/calibration/capabilities.asp</p>	<p>Fields of Calibration Dimensional Electromagnetics – DC/Low Frequency Time and Frequency Mechanical Thermodynamic</p> <p>This laboratory is compliant to ANSI/NCCL Z540-1-1994; Part 1. ((20/A01))</p>
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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) ^{Note 3,5}	Remarks
DIMENSIONAL			
GAGE BLOCKS (20/D03)			
Master Set Calibration Steel	0.010 in to 0.09375 in	3.4 μ m	
	0.100 in to 1.000 in	3.0 μ m	
	2 in	3.0 μ m	
	3 in	3.0 μ m	
	4 in	3.6 μ m	
	5 in	4.3 μ m	
	6 in	4.5 μ m	
	7 in	5.3 μ m	
	8 in	5.3 μ m	
	10 in	6.5 μ m	
	12 in	7.4 μ m	
	16 in	11 μ m	
	20 in	12 μ m	
Chrome Carbide	0.050 in to 0.09375 in	3.0 μ m	
	0.100 in to 1.000 in	3.0 μ m	
	2 in	3.0 μ m	
	3 in	3.0 μ m	
	4 in	3.3 μ m	
Tungsten Carbide	0.050 in to 0.09375 in	3.0 μ m	
	0.100 in to 1.000 in	3.0 μ m	
	2 in	3.0 μ m	

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The Standards and Calibration Laboratory (S&CL) performs calibration to the manufacturer's specified accuracy for measuring and test equipment. Test Uncertainty Ratios (TUR), the ratio of unit under test uncertainty to standard measurement process uncertainty, are 4:1 or greater for calibrations performed.

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Typical equipment used in the Battery Test Center:

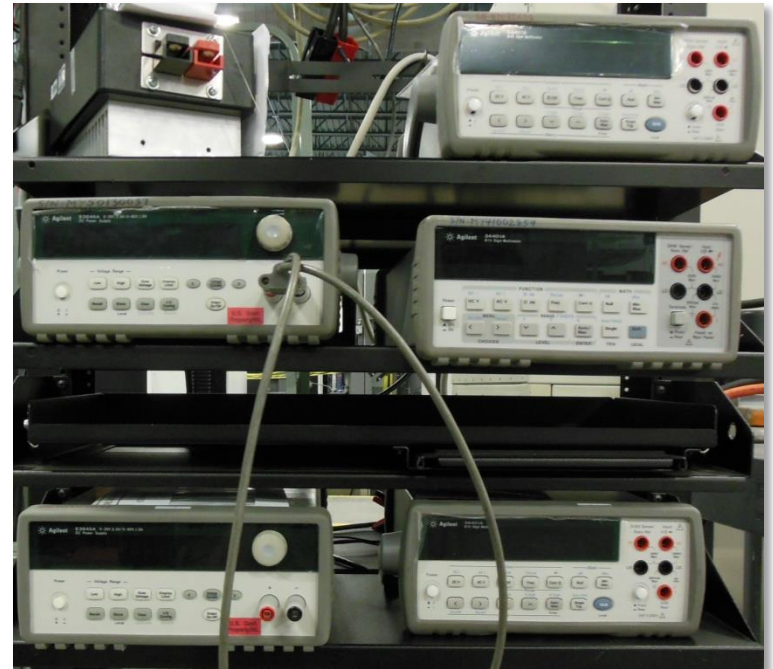
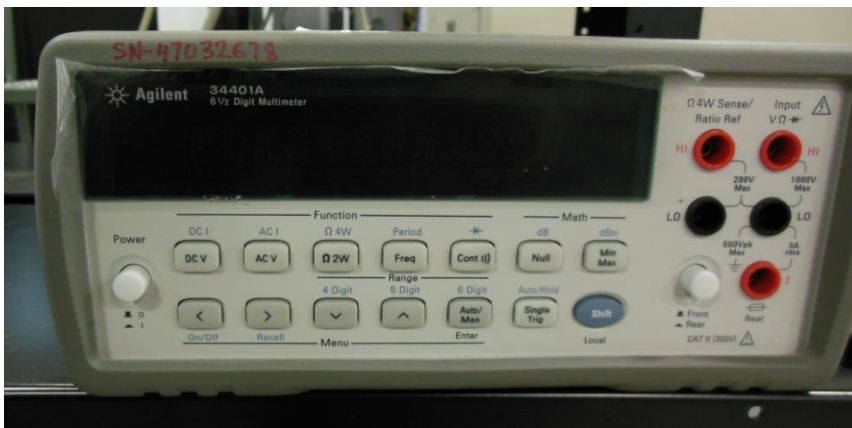
- 1. 1-year specification on the Agilent 34401A DVM at 100 mV DC is ± 0.0085 mV and the S&CL's best measurement capability at 100 mV DC is ± 0.0004 mV**
- 2. The specs for the 50A current shunt is $\pm 100 \mu\Omega$ S&CL's best measurement capability is $\pm 0.35 \mu\Omega$**
- 3. Thermo-well is Accuracy ± 0.3 deg C and uniformity ± 0.2 deg C @ 100 deg C S&CL's uncertainty is ± 0.034 °C; our best measurement capability from 0 °C to 420 °C ranges from 5.7 mK at 0 °C to 9.5 mK at 420 °C.**

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- **Equipment used is sized or scaled appropriately for the calibration being performed.**

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What do we calibrate?



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What do we calibrate?

- 1. Voltage on every channel**
- 2. Current on every channel**
- 3. Temperature (every channel used, end-to-end preferred)**
- 4. Balances (mass)**
- 5. Torque wrenches (for lugs and connectors)**

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Process

- 1. Select standards for calibrations to be made**
- 2. Verify that all standards are current**
- 3. Perform Calibration AND Verification beyond the conditions to be used***
- 4. Document everything**

***If max current to be used is 25 A, then verify at 30 A**

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Process

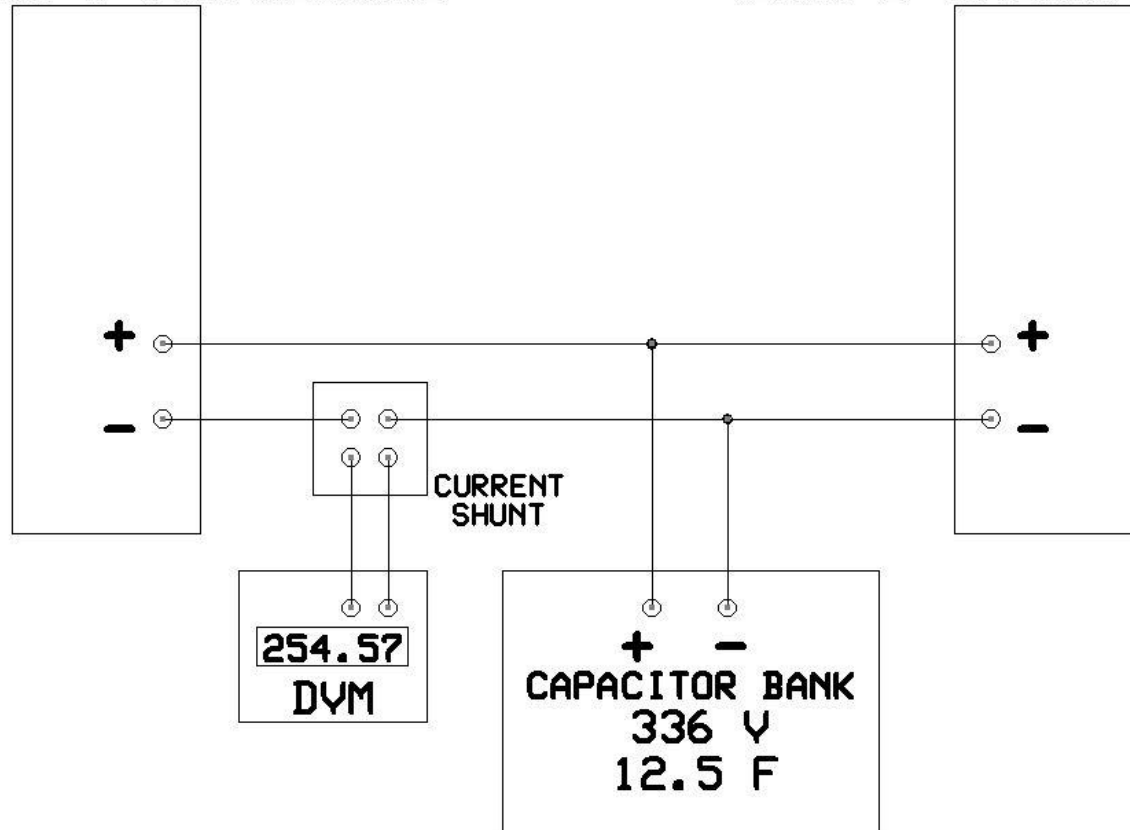
- **Special conditions for some calibrations are set up**
 - 1. Supplemental current for some systems**
 - 2. Thermo wells with chillers to reach appropriate temperatures**

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Supplemental current example

TESTER "A" BEING CALIBRATED

TESTER "B" SUPPLYING CURRENT



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Frequency

- 1. Prior to any new testing**
- 2. Once per year perform verification**
 - Account for anomalies and re-cal**
- 3. Perform verification after testing longer than 3 (three) months**
- 4. Prior to equipment changes**

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Documentation

- 1. All equipment used, including expiration dates.**
- 2. Date / Performer**
- 3. Verification record for every measurement of every channel**
- 4. Special conditions**
 - All calibration documentations are maintained with associated data for the life of the data.**

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Documentation

Voltage Verification Report - As Left

System Type: Lab system **Equipment Type:** Series 4000 **Serial Number:** A070703
Job Number: J01841 **Date:** Aug 4, 2011 **Certificate Number:**

Channel	Cal Date	Mode	V1 Ch	V1 Meter	Error	V2 Ch	V2 Meter	Error	V3 Ch	V3 Meter	Error	P/F
1	29 Oct 2007	Discharge	3.7510	3.7510	0.001%	2.5003	2.5004	0.002%	1.2508	1.2509	0.002%	Pass
1	29 Oct 2007	Charge	3.7510	3.7511	0.000%	2.5005	2.5004	0.001%	1.2508	1.2508	0.001%	Pass
2	29 Oct 2007	Discharge	3.7510	3.7511	0.002%	2.5002	2.5004	0.004%	1.2507	1.2509	0.004%	Pass
2	29 Oct 2007	Charge	3.7510	3.7511	0.002%	2.5003	2.5004	0.001%	1.2509	1.2508	0.002%	Pass
3	29 Oct 2007	Discharge	3.7510	3.7511	0.000%	2.5005	2.5005	0.000%	1.2510	1.2509	0.002%	Pass
3	29 Oct 2007	Charge	3.7508	3.7511	0.005%	2.5003	2.5004	0.002%	1.2507	1.2509	0.003%	Pass
4	29 Oct 2007	Discharge	3.7511	3.7511	0.001%	2.5006	2.5005	0.004%	1.2509	1.2509	0.001%	Pass
4	29 Oct 2007	Charge	3.7511	3.7511	0.001%	2.5005	2.5004	0.001%	1.2507	1.2508	0.003%	Pass
5	29 Oct 2007	Discharge	3.7510	3.7511	0.002%	2.5006	2.5005	0.002%	1.2509	1.2509	0.001%	Pass
5	29 Oct 2007	Charge	3.7511	3.7511	0.001%	2.5005	2.5004	0.001%	1.2508	1.2509	0.001%	Pass
6	29 Oct 2007	Discharge	3.7510	3.7511	0.002%	2.5003	2.5005	0.002%	1.2509	1.2509	0.001%	Pass
6	29 Oct 2007	Charge	3.7512	3.7511	0.003%	2.5005	2.5004	0.001%	1.2509	1.2508	0.000%	Pass
7	29 Oct 2007	Discharge	3.7510	3.7511	0.002%	2.5004	2.5005	0.001%	1.2508	1.2509	0.002%	Pass
7	29 Oct 2007	Charge	3.7511	3.7511	0.001%	2.5005	2.5004	0.001%	1.2508	1.2508	0.001%	Pass
8	29 Oct 2007	Discharge	3.7509	3.7511	0.003%	2.5003	2.5004	0.002%	1.2508	1.2509	0.002%	Pass
8	29 Oct 2007	Charge	3.7510	3.7511	0.000%	2.5003	2.5004	0.001%	1.2508	1.2508	0.001%	Pass



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